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OCCURRENCE OF SEXUAL MORPHS OF RUSSIAN WHEAT APHID, *DIURAPHIS NOXIA* (HOMOPTERA: APHIDIDAE), IN SEVERAL LOCATIONS IN THE SOVIET UNION AND THE NORTHWESTERN UNITED STATES

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Abstract.—*Diuraphis noxia* were collected in North America and the Soviet Union during autumn 1989. Sexual forms constituted more than half of Moldavian and Crimean collections and about nine percent of collections near and between Odessa and Kherson, Ukraine. Six oviparae were found in Idaho and Oregon, but they represented less than 1 percent of total collections. No sexuales were found in the Soviet Republic of Kirghizia. Moldavian *D. noxia* colonies readily produced sexual forms under natural autumn conditions, whereas an Idaho isolate of *D. noxia* produced no males or oviparae after 10 weeks under a 6:18 (L:D) photoperiod at 10°C. Under a photoperiod of 8:16 (L:D) at 20°C, Moldavian *D. noxia* produced sexual forms, but Syrian, French, Turkish, Jordanian and Kirghizian populations did not. A Kirghizian population did produce sexuales and eggs at 16°C and a photoperiod of 14:10 (L:D).

Key Words: *Diuraphis noxia,* Aphididae, sexuals

There are two overwintering strategies among Aphididae. Some populations (termed holocyclic) produce males and oviparae which must mate to produce viable overwintering eggs. Other populations (termed anholocyclic) overwinter in protected locations as viviparous females, and no sexual morphs are produced. Some populations can utilize either strategy depending upon climatic conditions.

The Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Homoptera: Aphididae), a serious pest of small grains, is indigenous to the Middle East, the Soviet Union, Afghanistan and probably western China (Hewitt et al. 1984). Holocyclic populations of *D. noxia* are known from the Soviet Union (Grossheim 1914). Sexual forms have been described briefly by Grossheim (1914), but no formal descriptions exist. On 7 IX 1989, Dr. Manya B. Stoetzel found an apterous male in a laboratory colony maintained at the USDA-ARS European Parasite Laboratory, Behoust, France, and originally collected in Kishinev and vicinity, Moldavia, USSR, 28 V–2 VI 1989 on wheat and barley by Dr. Tad Proprawski and Françis Gruber (M. B. Stoetzel, personal communication). Additional males

[1] Order reprints from Susan Halbert.

and oviparae have been obtained from this colony. *Diuraphis noxia* was recently introduced into South Africa and North America (Stoetzel 1987, Walters 1984). Prior to this article, no sexual forms of *D. noxia* have been reported from North America, although *D. noxia* has been reported as far north as 50° latitude in Canada (Jones et al. 1989). No sexual forms have been reported from South Africa.

The purpose of the surveys was to compare occurrence of the various morphs of *D. noxia* in the northwestern United States and the Soviet Union where *D. noxia* is native. Our preliminary attempts to force various populations of *D. noxia* to produce sexuales under laboratory conditions are presented here to support field observations and are not intended to be definitive experiments on the nature of triggering mechanisms for development of sexuales.

Methods

Live *D. noxia* were collected on wheat and barley from two fields in Moldavia (October 25–27, 1989), four fields in the Crimean Peninsula (October 31–November 2, 1989), five fields in the southern Ukraine (near and between Odessa and Kherson) (November 2–4, 1989), seven fields in the Kirghiz Inner Tian Shan Range of south central USSR (September, 1989), six fields in the Treasure Valley of Canyon County, Idaho and Malheur County, Oregon (November 14–16, 1989) and 2 fields in the Palouse area of Latah and Nez Perce Counties, Idaho (November 25–27, 1989). In the Ukraine and Moldavia *D. noxia* is quite rare, so every colony found was collected. In the Treasure Valley where *D. noxia* is more abundant, infested plants were selected along a 100 m transect within each field, and additional plants were collected in heavily infested areas of several fields. In the Palouse area, wild oat plants with obvious damage symptoms along the perimeter of a field previously in barley (Latah County) and within a winter wheat field (Nez Perce County) were collected. In Kirghizia, heavily infested wheat and barley plants were selected. In the Soviet Union and the Treasure Valley, immature aphids were kept on fresh wheat plants in plastic containers until they became adults. Nymphs with wing pads which died before reaching maturity were recorded as alatae. Other nymphs which died prior to reaching maturity were recorded as undifferentiated nymphs. Adult aphids were examined and preserved in 70% ethanol. In the Palouse, only adults were examined. Voucher specimens are on deposit at the All Union Research Institute for Biological Methods in Agriculture, Kishinev, Moldavia, U.S.S.R.; the USDA European Parasite Laboratory, Behoust, France, the University of Idaho Southwest Idaho Research and Extension Center, Parma, Idaho, U.S.A.; the Pasteur Institute, Paris, France; and the USDA-ARS Systematic Entomology Laboratory, Beltsville, Maryland, U.S.A.

In preliminary experiments, we have made attempts to force various populations of *D. noxia* to produce sexual morphs by subjecting them to short days and cool temperatures (Blackman and Eastop 1984). In Idaho, one of us (S.H.) maintained North American *D. noxia* individually in petri dishes supplied regularly with fresh leaves on moist cotton subjected to a photoperiod of 6:18 (L:D) at 10°C from February–April, 1988. A similar experiment was done at the USDA-ARS European Parasite Laboratory, Behoust, France using Moldavian, Syrian, Jordanian, French, Turkish and Kirghizian *D. noxia* kept at a photoperiod of 8:16 (L:D) at 20°C from October–December, 1989 (F.G. and T.P.).

Results and Discussion

Collections in the USSR.—No alatae or alatoid nymphs were found in the Ukraine or Moldavia (Table 1). In Moldavia all 26 of the adult *D. noxia* found or reared were oviparae. In the Crimean Peninsula, the only location where males were found, four fifths

Table 1. Morphs of *Diuraphis noxia* (Mordvilko) found in 6 locations in the southern Soviet Union and northwestern United States. 1989.

Location	Month of Collection	Number of Sites	Morphs Found				
			Alate Viviparae[1]	Apterous Viviparae	Oviparae	Males	Undifferentiated Nymphs[2]
Moldavia	October	2	0	0	26	0	1
Crimea	November	4	0	6	21	3	6
Ukraine[3]	November	5	0	89	9	0	0
Kirghizia	September	7	76	843	0	0	43
Treasure Valley[4]	November	6	107	401	5	0	70
Palouse	November	2	8	193	1	0	—[5]

[1] Includes alatoid nymphs in Treasure Valley collections.
[2] Aphids collected were maintained in cages to allow them to become adults before they were scored. Nymphs without wing pads which died before becoming adults are scored as undifferentiated nymphs.
[3] Fields near and between Odessa and Kherson.
[4] Fields in Canyon Co., Idaho and Malheur Co., Oregon.
[5] Fields in Latah and Nez Perce Counties, Idaho. Only adults were counted.

of the 30 adult aphids recovered were sexual forms (21 oviparae, 3 males). In the southern part of the Ukraine 9 of the 98 adult *D. noxia* recovered were oviparae. No sexuales were found in Kirghizian collections.

Diuraphis noxia is not common in Moldavia or the Ukraine in the autumn and is not considered an important pest. The infestations we observed affected isolated plants or patches up to 2 m in diameter. *Diuraphis noxia* was most common in volunteer grain. In winter wheat, infestations were found most often near field borders or in places where plants were relatively sparse. Plants showing characteristic *D. noxia* damage typically had one or two *D. noxia*. Other cereal aphids, particularly *Rhopalosiphum padi* (L.), *Rhopalosiphum maidis* (Fitch) and *Sitobion avenae* (Fabricius), were common. In North America and Kirghizia, *D. noxia* is much easier to find, and infested plants often have large colonies of aphids.

Collections in North America.—It was surprising to find oviparae in the Treasure Valley and the Palouse in Idaho and Oregon. In all, 6 oviparae were found from two fields in the Treasure Valley and one field in Latah Co., Idaho among 785 *D. noxia* examined from a total of 8 fields. No males have been found to date, but the presence of oviparae opens the possibility that a small percentage of the North American *D. noxia* population is now holocyclic. Males, which were much less common than oviparae in the Soviet Union, may have been overlooked in our limited North American collections. The fact that oviparae were found in several fields in Idaho and Oregon increases the possibility that an occasional male could find a mate. The unusually harsh winter of 1988/9 in the Pacific Northwest USA could have provided a heavy selective advantage to holocyclic populations which resulted in their reaching detectable levels this year.

Another possible explanation for the presence of oviparae follows from Blackman (1974). He has reported clones of *Myzus persicae* (Sulzer) which he terms androcyclic because they produce occasional males but no oviparae. Similarly, it is possible that North American *D. noxia* are gynocyclic, occasionally producing oviparae but not males.

Preliminary laboratory experiments.—North American *D. noxia* subjected to a photoperiod of 6:18 (L:D) at 10°C for 10 weeks produced no sexual morphs. Syrian, Jordanian, French, Turkish and Kirghizian *D. noxia* produced no sexual morphs after three months at a photoperiod of 8:16 (L:D) at 20°C, but a Moldavian population kept

under the same conditions produced oviparae, males and eggs. A Moldavian population collected in August, 1989, and propagated under natural autumn conditions produced abundant sexuales and eggs by 23 October. Surprisingly, a Kirghizian population maintained for two months at 16°C and a photoperiod of 14:10 (L:D) at the European Parasite Laboratory produced sexuales and eggs. More research is needed on mechanisms for triggering production of sexuales in *D. noxia*.

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